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EDITORIAL

VICTORY

THE war against Germany officially came to an end at one minute past midnight on Wednesday, May 9, 1945. So ended the gravest trial that this nation has been called upon to face in all its great and glorious history. For more than five years our citizens have had to toil and sweat to withstand the efforts of cruel, perverted men who would have thrown civilisation and all it stands for aside in order that barbarism might reign supreme. There have been tears also, for many loved ones have paid the supreme sacrifice and the terrors and spite of modern war have been vented upon the civilian population.

It was right that our great leader should decree two days of relaxation that we might give thanks for the victory vouchsafed to us, and enjoy a brief spell of relief and joy in order that we might steel ourselves for the further gigantic tasks ahead. Now how does the future affect the Veterinary Surgeon? Within the memory of those who are still with us there have been many great changes. The horse has reigned supreme and he has passed to a secondary place. Our work, and particularly that of the great majority, i.e., the practitioners, has been completely reorientated. The period between the two wars saw the death of the great days of horse practitioner and the rise of small animal practice to a position of major importance. In fact, it can be said with truth that but for this fortunate circumstance many practices would have ceased to be of sufficient economic value to support a man of professional status. As it was, great areas became depopulated of veterinary surgeons; in others the small animal work literally functioned as a subsidy to enable a man to live in a town or village and provide skilled aid for other animals, such as those of commerce and the farm.

When this war came we witnessed another great change, and one which we all welcomed. Great calls came to us to aid agriculture. We were able to fill the gap, for our training prepared us for any emergency. The response was great, and the Government recognised our worth by completely reserving our members for duty in their own sphere. More and more work came our way amongst the animals of the farm, until we were at our wits' end to answer all the calls. Now why did this revolutionary change come about? It is no good deluding ourselves. It was because of the exigencies of war. Agriculture became a priority No. 1. Agriculture had to be made efficient and prosperous, and no longer the cinderella of our industries. How was this effected? By decree, by encouragement, by

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promise of a better future, and, above all, by an outpouring of money in the guise of subsidy. The whole economics of the farm changed radically. Values mounted and consequently our services were in great demand. The country became more and more conscious of the land. Literally, we became an agricultural community. Now that the European war has drawn to its close it behoves us to take stock of the future. At present the profession is orientated on the farm. Will it remain so? There is no doubt that in this country agriculture can remain a priority industry if in turn it is reorientated to suit altered circumstances. It must remain prosperous, but that prosperity must not be based on subsidy, for that is a fictitious prosperity subject to the will or whim of the taxpayer. In peace the taxpayer will not stand for it. Agriculture, like any other industry, must base its future on consumer values. This country can play a great role in world affairs, or it can subside to a position of insignificance. What are the factors which rule this choice? They are simple. Are we to be pre-eminently an industrial country or pre-eminently an agricultural one? We can choose either, but great issues are at stake. If we remain pre-eminently industrial we remain in the first rank of world powers, for we will have then at hand the means of international economic exchange and our international trade will be good. If we choose to be pre-eminently agricultural we must resign ourselves to the level of a seventh-rate world power, for although we may be self-sufficient we shall lack the material ways and means of international exchange.

There can be no doubt in which direction the majority of minds will turn, but this does not mean that agriculture need be relegated to a minor role. How can we establish agricultural well-being? The answer again is a simple one, one which is almost solved for us by a beneficent nature. It is that we take full advantage of our soil and climate, which is so arranged that we can raise stock of world pre-eminence and become the animal nursery of the world. We can make these islands the place where all will turn when in search of stock of the highest standard, no matter what species. By selective breeding, by increasing our knowledge of the care, management and nutrition of our animals we can attain this end. We cannot compete economically with those of the wide open spaces in the growing of cereals or of the common or commercial stock, but, on the other hand, they are at a great disadvantage when it comes to producing the high-class pedigree animal.

Now in this metamorphosis the veterinary surgeon has a great part to play. To him the breeder will look for advice and guidance, no matter if the animal be horse, ox, sheep, pig, dog, or even the cat. Here is our opportunity. Let us seize it and so render our greatest service to our country and, incidentally, to ourselves, for our usefulness, our future and our prosperity are bound indissolubly with the animal world. Here is the golden opportunity; let it not pass, for it may not come our way again.

General Articles

THE ACTION OF THREE DIFFERENT BACON-BRINES ON PATHOGENIC BACTERIA

By ALFRED GINSBERG, Dr. Med. Vet., Ph.D.(Edin.).

On account of its chemical composition, meat belongs to that particular group of food-stuffs which in a fairly short time, under natural conditions, undergo the process of decomposition.

There are many reports to the effect that meat poisoning occurs quite often after the consumption of prepared meat, such as bacon, ham and continental sausages—eaten in many countries raw and being only pickled and smoked. This might suggest that bacon-brine is not strong enough to kill micro-organisms, which either invaded the meat during the animal's life or post-mortem during the dressing of the carcass or preparation of the flesh.

To investigate this a special study of the action on pathogenic bacteria of three different brines, used in the the curing process, has been carried out in the following research.

Material and Methods

Previous research was carried out under laboratory conditions, without taking into consideration the methods and brine used for preserving meat in commercial plants (4, 5, 7, 8, 11, 12, 16).

On commencing the laboratory part of this research every practical detail was taken into account, and even original bacon-brine was used. Purely laboratory experiments were carried out and described merely for the purpose of comparison. It should be emphasised here that strict aseptic methods have been observed only where it was absolutely necessary from the bacteriological point of view. In all other cases, meat and brine were handled in the very same way as it is done in practice in order to obtain approximate results.

The pickle used for the experiments was obtained from Kersans, Ltd., Edinburgh. Its salt concentration was 24-26 per cent., with an average pH. of 7.1. Every fresh supply of brine was first examined bacteriologically and the pH. ascertained. For the curing of inoculated meat, only brine from a protected tank was used.

The meat required for the experiments came from the Edinburgh Municipal Abattoir detention room.

The organisms were obtained from the National Collection of Type Cultures, Lister Institute, London, with the exception of staphylococcus strains, which were isolated from a suppurative human wound and a superficial abscess of a horse.

All strains were tested before use, and at each inoculation of meat fresh subcultures were made so as to ascertain the best viability of the organisms.

The number of organisms per c.c. was estimated by comparison with standard opacity tubes. The basic suspension from which further dilutions were made was 200,000,000 organisms per c.c. For the experiments described, suspensions of 200,000,000 and 200,000 bacteria per c.c. density only were employed.

The suspensions obtained were used in two ways: firstly, by copying the curing methods prescribed by the bacon trade. The second one was carried out in test tubes merely for comparative purposes.

Pieces of meat of equal size, of average weight of 50 gr., were inoculated with above-mentioned suspensions and put into a glass jar and covered with

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bacon-brine. Three pieces of meat were inoculated with a suspension of 200,000,000 and three others with 200,000 bacteria per c.c. Then all six were divided into three sets composed of two jars, i.e., one of each containing a piece of meat inoculated with 200,000,000 and 200,000 bacteria. The bacteria were allowed to remain in the different brines for periods of 2, 5, 7 and 21 days.

Results

The results obtained are shown in Tables 1-5. The experiments dealt with the action of three different brines, i.e., normal bacon-brine, bacon-brine plus 0.5 per cent. of *borax*, and bacon-brine in which the saltpetre was replaced by 0.6 per cent. of *sodium nitrate* on : *Staphylococcus aureus, B. typhi murium, Salmonella Reading, B. enteritidis Gaertner, Proteus vulgaris,* and *Chromobacterium prodigiosum.*

Discussion

To ascertain whether the length of time normally adopted in curing (2-7 days) is sufficient to affect the viability of pathogenic micro-organisms, the most commonly found " meat poisoning bacteria " were treated with pure bacon-brine, bacon-brine plus 0.5 per cent. of borax, and brine in which potassium nitrate was replaced by 0.6 per cent. of sodium nitrite. The results of the tests carried out with suspensions of these bacteria both in pure brine and inoculated into pieces of meat which were then cured for a period ranging from two to twenty-one days, gave rather a negative answer to that question.

Staphylococcus aureus of both human and animal origin inoculated into pieces of meat in suspensions of 200,000,000 and 200,000 organisms per c.c. survived 21 days of curing at 8 degrees C. and were fully toxic at the end of that time. Even when kept in pure brine without a nutrient medium, growth was still obtained on the 21st day after incubation in a curing temperature of 8 degrees C. The only difference observed was that the organisms grown from the 200,000 per c.c. suspension were no longer hæmolytic.

B. typhi murium, Salmonella Reading and *B. enteritidis Gaertner* similarly survived 21 days in 8 degrees C. when inoculated into pieces of meat. The fact that the suspensions in brine alone were killed off by the 21st day can only serve as proof that the disinfectant action of brine on micro-organisms is stronger and quicker when there is no nutrient medium present.

From the meat inspection point of view, that fact has no significance, because bacteria will never lack a nutrient medium during the process of preserving meat.

According to the results obtained, one can state that " meat poisoning bacteria " are resistant to the measures usually employed for pickling with bacon-brine consisting of salt, saltpetre and sugar. Taking this into account, therefore, it can be further stated that these methods cannot be regarded as a means of rendering infected meat harmless and fit for consumption, even after 21 days of curing (continental meat inspection regulations).

In a temperature of 22 degrees C. all bacteria were killed in a shorter time. This is, however, of no practical importance for the trade. Meat preserved in this temperature can be of some value for home use only when consumed shortly after it has been pickled.

Curing at an incubation temperature of 37 degrees C. killed the bacteria investigated in general after 2-5 days; only the very resistant *Staphylococcus*

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TABLE 3.

Comparative Histograms showing the action of Bacon Brine, Bacon Brine +0.5 per cent. Borax, and Bacon Brine in which Saltpetre is replaced by 0.6 per cent. Sodium Nitrite, on *Salmonella Organisms* at temperatures of 8°c., 22°c. and 37°c., in (A) test-tubes, and (B) pieces of meat for periods of 2, 5, 7 and 21 days.

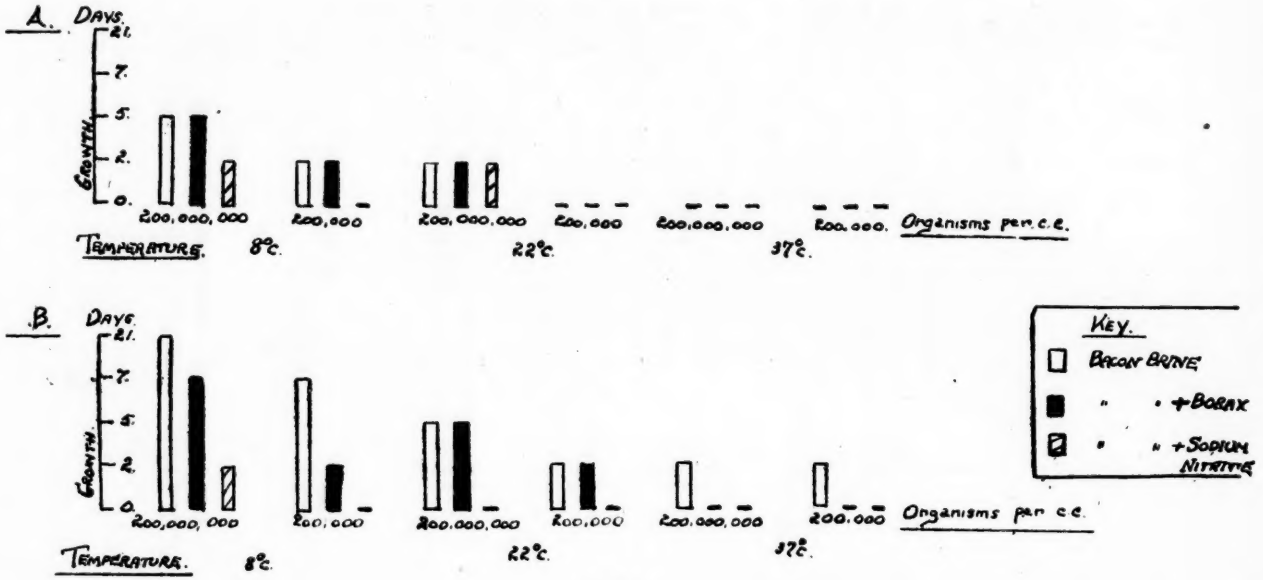

TABLE 4.

Comparative Histograms showing the action of Bacon Brine, Bacon Brine plus 0.5 per cent. Borax, and Bacon Brine in which Saltpetre is replaced by 0.6 per cent. Sodium Nitrite on *Proteus Vulgaris*, at temperatures of 8°c., 22°c. and 37°c., in (A) test-tubes and (B) pieces of meat for periods of 2, 5, 7 and 21 days.

aureus survived 7 days. This is of some interest from the bacteriological point of view only, as it cannot be adopted in practice.

To shorten and strengthen the pickling process, borax and sodium nitrite were added to the bacon-brine.

When 0.5 per cent. of borax was added to normal bacon-brine, *Staphylococcus aureus* inoculated into pieces of meat survived 21 days of curing in a temperature of 8 degrees C. and showed toxicity by hæmolysing blood agar. The effect of this mixture was found to be accentuated only in liquid solutions where hæmolysis ceased by the seventh day, a growth was still obtained when high density suspensions were sub-cultivated after 21 days of pickling.

Comparing the results of the action of brine plus 0.5 per cent. of borax on *B. typhi murium, Salmonella Reading, B. enteriditis Gaertner, Proteus vulgaris* and *Chromobacterium prodigiosum,* one can see that the germicidal action of brine plus borax is definitely more effective, and the resistance of the organisms less, than when normal brine is used.

Do these results indicate that borax is a chemical fit for the sterilisation of infected meat?

From the meat inspection point of view, the answer to this question must be in the negative. *Staphylococcus aureus* did not merely survive the usual period of seven days, but also the period of 21 days demanded by the law for rendering infected meat fit for consumption. Staphylococcus did not only show growth when sub-cultivated, but retained its hæmolytic property in full strength. The other five bacteria investigated were, however, less resistant and ceased to live by the seventh day; nevertheless, this is too long a period to indicate that borax is of real disinfectant value for rendering infected meat fit for consumption.

The second chemical, much more commonly used on the Continent and manufactured a great deal as so-called "quick pickling salt," is sodium nitrite. When replacing the saltpetre of the bacon-brine by 0.6 per cent. of sodium nitrite, *Staphylococcus aureus* still grows at 8 degrees C. after 21 days, but its hæmolytic power has gone by the second day of curing.

All other organisms investigated in this research were killed off by this brine mixture by the second day.

From the meat inspection point of view, there are no objections to the use of common salt with the addition of saltpetre or sodium nitrite in definite harmless quantities for curing sound meat. There should, however, be strong restrictions in the use of borax at any time, and sodium nitrite when used in such strong doses as necessary to intercept a decomposition process or achieve a rapid curing.

To prevent flaunting of the laws owing to different conditions of prohibition regarding certain preservatives all over the world, international laws should be enacted to regulate the production and use of food preservatives.

Conclusions

The results obtained by this research prove the following facts:—

(1) Pickling, as a means of rendering infected meat fit for human consumption, is out of the question because of:—(a) slight and uncertain disinfectant action on pathogenic bacteria; (b) length of time required for the killing of meat-poisoning organisms.

(2) The pickling process and the bactericidal action are greatly hastened by replacing saltpetre with sodium nitrite.

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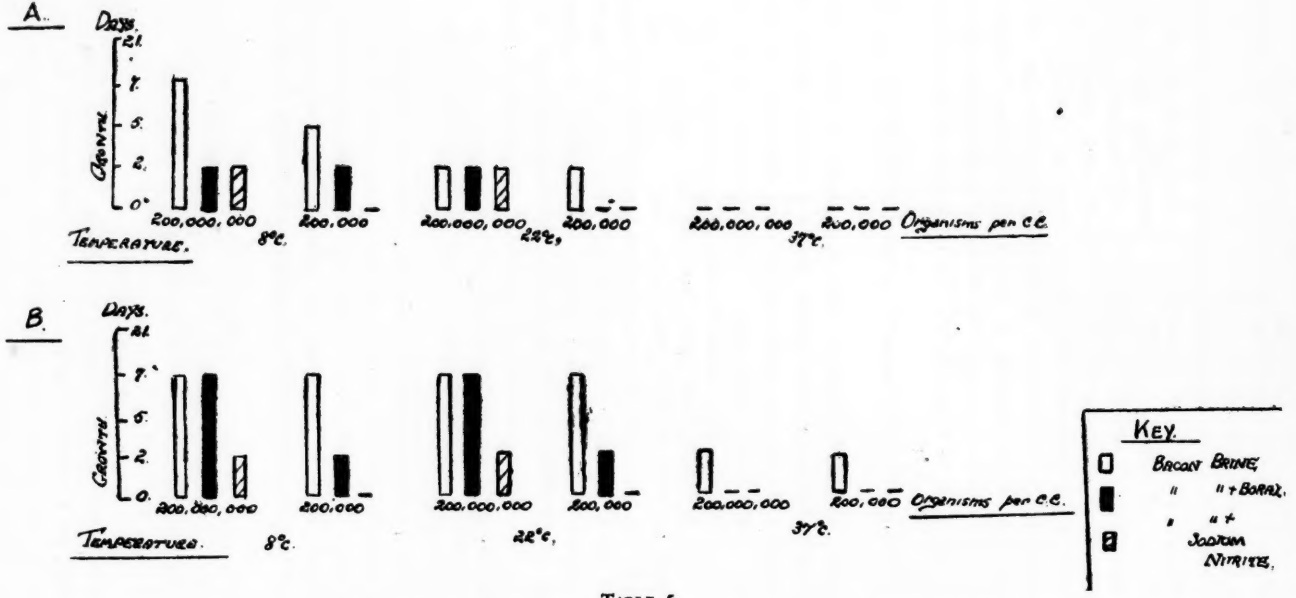

TABLE 5.

Comparative Histograms showing the action of Bacon Brine, Bacon Brine plus 0.5 per cent. Borax, and Bacon Brine in which Saltpetre is replaced by 0.6 per cent. Sodium Nitrite, on *Chromobacterium Prodigiosum*, at temperatures of 8°c., 22°c. and 37°c., in (A) test-tubes and (B) pieces of meat for periods of 2, 5, 7 and 21 days.

(3) The use of sodium nitrite in a mixture with common salt and sugar is a valuable preservative, shortening the curing time.

Summary

The research dealt with the action of bacon-brine, bacon-brine plus 0.5 per cent. of borax, and bacon-brine in which saltpetre has been replaced by 0.6 per cent. of sodium nitrite, on *Staphylococcus aureus, B. typhi murium, B. enteritidis Gaertner, Salmonella Reading, Proteus vulgaris* and *Chromobacterium prodigiosum.*

Experiments were made both with infected brine solutions and inoculated pieces of meat. Methods and curing times were chosen according to the rules obtaining in the meat production trade.

Bacon-brine mixtures, in doses not dangerous to human health, stops the growth of meat poisoning bacteria too late to be considered of value for rendering infected meat fit for human consumption.

Sodium nitrite mixed with common salt can be recommended for shortening the curing process of sound meat.

Acknowledgments

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A CASE OF FOOD POISONING IN MAN PROBABLY CAUSED BY THE CONSUMPTION OF A DUCK EGG*

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On May 23, 1944, a man aged 49 was admitted to Rotherham Municipal Hospital suffering from acute gastro-enteritis. Apparently symptoms first appeared on May 21, a few hours after eating a duck egg fried with ham for breakfast. *Bact. typhi-murium* was isolated from the blood and fæces of the patient, who subsequently died on May 27.

The duck egg was obtained from a neighbour on May 21 and had been picked up that morning, although the time of laying is unknown. The egg appeared quite normal. The premises where the ducks were kept adjoined a

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railway line on one side and a canal on the other, and were also used for keeping pigs, fowls, horses, rabbits and goats. Four ducks and a drake were kept, and there had been no recent deaths in the ducks or fowls. The duck eggs had been eaten regularly by the family as well as by neighbours and their children, and there had been no complaints of any description during recent months. The premises were in a most unsanitary condition, consisting of crude wooden buildings with poor floors and no proper drainage. Rats were prevalent, but no attempt had been made to exterminate them by the use of poisons. No mice were seen.

A bacteriological examination was carried out at the County Public Health Laboratory on three samples of duck droppings and a duck egg, but with negative results.

Examination of the Ducks' Sera

Blood samples were taken from each of the four ducks and from the drake, and examined for agglutinins to *Bact. typhi-murium*. The tests were carried out with O and specific H suspensions, obtained from the Standards Laboratory, Oxford. The standard drop method was employed, using dilutions of 1 : 25, 1 : 50, 1 : 125 and 1 : 250. The tubes were placed in a water bath at 55 deg. C. and read after two hours, the O agglutinations being finally examined after standing at room temperature overnight.

As a result of the initial test, agglutinins to *Bact. typhi-murium* were demonstrated in the sera of three of the ducks, while duck 1149 and the drake were negative. The four ducks were purchased and brought to Weybridge for further observations. Four further tests were carried out before the ducks were killed for examination, and it will be seen from the table that there was considerable fluctuation in the serum titre to both O and H suspensions. This variation in agglutinin content of ducks' sera had been recognised by Gordon and Garside (1944), and as a result of a large number of observations they were able to associate to some extent this fluctuation with ovarian activity. They observed that ducks reacting positively to an agglutination test for *Bact. typhi-murium* would give a negative reaction at a later test when the ovary became inactive, although in many cases it was subsequently possible to isolate the organism from the ovary.

While at Weybridge each duck was placed in a separate metal coop with a wire floor. It was hoped to culture all the eggs laid, but unfortunately, though the ducks were in lay when they arrived, their egg production rapidly decreased, and they laid a total of only 16 eggs before going completely out of production. Two of the four ducks died on September 25, 1944, and since the remaining two ducks were still not in lay they were sacrificed for examination on October 25.

Examination of the Ducks' Eggs

Both authors have had considerable experience in the bacteriological examination of eggs in connection with bacillary white diarrhœa of chicks and salmonella infections of ducks, and the following technique has been found to be the most effective. The highest rate of isolation is obtained from eggs incubated at 37 deg. C. for a period of 5-7 days. In all cases the eggs were incubated for that period before examination.

Technique.—The eggs were placed in a wooden holder and a few drops of methylated spirit were poured over the shell in the region of the air space.

Duck No.	Agglutination Tests										Results of cultural examination of 16 eggs laid between 7.6.44 and 6.8.44	Results of bacteriological examination of ducks
	1st test 7.6.44		2nd test 22.6.44		3rd test 4.7.44		4th test 8.8.44		5th test 25.10.44			
	O titre	H titre	O titre	H titre	O titre	H titre	O titre	H titre	O titre	H titre		
1146 ...	+++ 1 : 250	+++ 1 : 250	—	—	—	—	++ 1 : 50	++ 1 : 250	Died		All negative.	Negative (*E. rhusiopathiæ* from liver, heart, spleen and gall-bladder).
1150 ...	+ 1 : 250	+ 1 : 50	—	—	—	+++ 1 : 50	+ 1 : 25	—	+ 1 : 125	++ 1 : 250	*Bact. typhi-murium* from yolk, yolk and white, and shell of egg laid on 23.6.44.	*Bact. typhi-murium* isolated from ovary.
1147 ...	+ 1 : 250	—	—	—	—	—	+ 1 : 25	—	Died		*Bact. typhi-murium* from shell of egg laid 23.6.44. *Bact. typhi-murium* from yolk, and from yolk and white of egg laid 11.7.44.	*Bact. typhi-murium* isolated from ovary.
1149 ...	—	—	—	—	—	—	—	—	—	++ 1 : 50	All negative.	*Bact. typhi-murium* isolated from intestinal tract.
Drake ...	Not Purchased											

+++ Complete agglutination. ++ Partial agglutination. + Slight agglutination. — No agglutination.

The spirit was ignited and allowed to burn off and a hole bored in the shell with a dentist's electric drill, which had been previously sterilised in methylated spirit. A sterile Pasteur pipette was inserted through the hole and approximately 1 ml. of yolk was withdrawn and inoculated into 5 ml. of tetrathionate broth. In this way it was possible to obtain yolk without its coming in contact with the egg-white or the shell. The rest of the contents of each egg was broken and poured through a sterile funnel into a flask containing 100 ml. of tetrathionate broth. The shell was then ground up with fine sterile sand and placed in another flask containing 100 ml. of tetrathionate broth. The cultures were incubated at 37 deg. C. for 18-24 hours and a loopful plated on to MacConkey's agar and on to brilliant green agar (1/75,000). Suspicious colonies were picked off and sown into lactose, maltose, dulcitol, 10 ml. of beef infusion broth, and on to an agar slant. Organisms which failed to ferment lactose but fermented maltose and dulcitol with gas production were then tested by the rapid slide agglutination method with a number of the salmonella sera supplied by the Oxford Standards Laboratory. To complete the identification of the organisms, agglutinations to titre were carried out, using both *Bact. typhi-murium* O and H specific sera.

Results.—Three of the 16 eggs examined yielded *Bact. typhi-murium.*

(1) Egg laid by duck 1150 on June 23; *Bact. typhi-murium* was isolated from all three cultures, i.e., from yolk, yolk and white, and from the ground-up shell.

(2) Egg laid by duck 1147 on June 23; *Bact. typhi-murium* was isolated from the shell only.

(3) Egg laid by duck 1147 on July 11; *Bact. typhi-murium* was isolated from yolk, and yolk and white, but not from the shell.

The titres of these birds at the tests previous to the laying of the infected eggs are of interest. Ducks 1150 and 1147 gave completely negative reactions in the dilutions used, the day before eggs (1) and (2) were laid; while 1147 gave a negative agglutination seven days before laying the other infected egg.

Post-mortem and Bacteriological Examinations of Ducks

Cultures were made from the liver, heart, gall-bladder and spleen, and sown into peptone broth tubes and on MacConkey agar plates. The entire ovaries were ground up and placed in 100 ml. quantities of tetrathionate broth, while the contents of the intestinal tracts were squeezed into similar flasks of tetrathioanate broth, and after 24 hours' incubation at 37 deg. C. were plated on MacConkey's agar and brilliant green agar 1/75,000. The isolation and identification of *Bact. typhi-murium* was then carried out as described for the egg.

Results.—Bact. typhi-murium was isolated from the ovaries of ducks 1147 and 1150, and from the intestinal tract of duck 1149.

It will be seen that at the test immediately before death duck 1147 had shown slight agglutination in the lowest dilution of 1 : 25, and then only to the O suspension, and at two previous tests had given completely negative reactions. Duck 1150 gave slight agglutination at 1 : 125 with the O suspension and partial agglutination to 1 : 250 with the H specific suspension of *Bact. typhi-murium* the day it was killed, but it had previously given one completely negative result. No agglutinins were demonstrated in the serum of duck 1149 until the final test, when a reaction of 1 : 50 was obtained to *Bact. typhi-murium* H. specific suspension. This again supports the contention of Gordon and

Garside that the routine testing of ducks is of doubtful value, since a negative result may be obtained from a duck in which the organism can be demonstrated in the tissues.

It is of interest to note that *Erythsipelothix rhusiopathiæ* was cultured from the liver, heart, spleen and gall-baldder of duck 1146.

Discussion

There are numerous references in European literature to food poisoning in human beings arising from the consumption of duck eggs, and a number of outbreaks in which duck eggs were implicated are mentioned in the annual reports of the Chief Medical Officer, Ministry of Health (1926, 1931, 1932, 1934, 1935, 1937 and 1938). Some of these outbreaks were described by Scott (1932); in three of them he isolated the same bacterial species from one or more eggs obtained from the same flock of ducks as the incriminated eggs. Warrack and Dalling (1932 and 1933) showed that ducks in apparent health could lay eggs infected with *Bact. enteritidis* and *Bact. typhi-murium*, and that one source of infection was the ovary. Gordon and Garside (1944) isolated *Bact. enteritidis* var. *essen* from the ovaries of 55 (48 per cent.) out of 113 ducks examined; but they were unable to demonstrate the transmission of the organisms through the eggs from these ducks by cultural examination either of over 2,400 eggs, or of ducklings hatched from their eggs.

The evidence recorded in the present paper appears to be more convincing than any so far produced in this country incriminating the duck egg as a source of gastro-enteritis in man. Not only were reactors to *Bact. typhi-murium* found in the flock from which the suspected egg was obtained, but the same organism was isolated from the yolk and shell of three of the 16 eggs laid by the four ducks, from the ovaries of both ducks which laid the infected eggs, and from the intestinal tract of a third duck.

Summary

Bact. typhi-murium was isolated from the blood and fæces of a patient who died of gastro-enteritis following on the consumption of a fried duck egg. A fortnight later, agglutinins to *Bact. typhi-murium* were found in the sera of three of the four ducks composing the flock from which the egg was obtained; the serum of the fourth duck became positive after a further four months. *Bact. typhi-murium* was cultured from the yolk and shell of three of the 16 eggs laid by these four ducks, and the same organism was isolated from the ovary of the two ducks which laid the infected eggs, as well as from the intestinal tract of a third duck.

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CASTOR-BEAN POISONING IN HORSES

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in collaboration with
the late H. ANDREW, M.R.C.V.S., and the late G. W. CLOUGH, D.Sc.

RECENTLY, when going through my records of interesting cases, I came upon notes, made at the time, of a series of cases of castor-bean poisoning in a stud of working horses. The veterinary surgeon who was called in in the first instance was my friend, the late Hugh Andrew, of the Borough, London. He called me in consultation, and subsequently we had the assistance of the late Dr. Clough. There are not many cases of castor poisoning in horses on record and, as in this case, many animals were affected and one was able to watch progress from start to finish, it is my duty even at this late hour to place our observations on record.

The outbreak occurred in a stud of 48 horses in February, 1931. The owner worked some of the horses in his own contracting business, but the majority were let out on hire in single units. As his stud increased in numbers, the owner established his own forage department, wherein cutting and mixing were done. This was a successful venture, and at the time of the incident all the hirers of his horses were purchasing their forage from this central depot. The hired horses were stabled in widely separated premises. The home stable contained 12 animals, which were used for the purposes of the owner's own cartage business and to act as replacements for hired-out animals in case of illness, etc. They were all of the cob or light vanner type and of various ages, most of them being relatively young toothed.

Early in February, 1931, the owner received a telephone message that one of the hired horses had been taken ill whilst at work. He gave instructions for the horse to be sent home and a replacement was provided. Mr. Andrew was called and he found a cob in good bodily condition but sweating profusely and blowing. It had a straggling rocky gait and a temperature which was slightly elevated. Its pulse and heart beats were tumultuous, and there were tetanic spasms in the muscles, especially those of the hind limbs. Visible mucous membranes were injected and dark. The horse stood back in the stall and would not eat. The chest was clear on auscultation and there were no throat lesions. There were signs also of some abdominal pain, not acute, but there was periodical straining and a diarrhœa sufficient to soil the hocks and buttocks.

The history given by the carman was that on the previous night the horse was in its usual health. In the morning he put food in the manger. The horse went to it as usual, but after eating a little it stood back and refused to take any more. As the animal appeared to him not to be ill he took it out to work, taking a supply of food in a nosebag. At breakfast time this food was refused. It was not until the horse had been out for about two hours that the carman recognised that there was something seriously wrong. It became unsteady on its feet, showed some distress and threatened to fall. He pulled up, removed it from the vehicle and telephoned the owner.

Later that morning, whilst Mr. Andrew was making his examination, further telephone calls came to the owner. The animals reported ill were sent for and stories similar to the above were told, except that at this time No. 1 was the only one showing diarrhœa. The same story was repeated time after

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time during that day and the following two days, until the owner had his entire stud laid by and his business was in chaos.

His stables and yard were full of sick horses. The degree of illness varied. Some were only dull, others showed a rocky gait, whilst others were in an acute state of distress. At this time I went to see the animals with Mr. Andrew. I found conditions as described above, and in the acutely affected cases the tetanic spasms and the tumultuous heart and pulse were very striking. The heart was beating with such force that it shook the entire body, as does spasm of the diaphragm, and one could palpate and auscultate the heart beats over the region of the hind quarters. I had never seen anything like this before, but both Mr. Andrew and I came to the conclusion that the cause was not one of bacterial infection, for temperature, chest, throat and abdominal symptoms did not support such a theory and, further, the majority of the animals had not been in contact with one another, and in those cases where they shared stables with other owners' horses the latter horses were reported to be all right. The common factor to all affected horses was the food. This was examined and appeared to be of good quality. However, as two chickens and a rabbit in the yard died rather suddenly and they had been fed from the common source a more critical examination was made of the food. This was all in the mixed state and in sacks. Samples from many bags were taken, sieved and examined in detail. We found some portions of husk which resembled those of castor-bean. A reasonable sample was obtained and submitted to Dr. Clough. His report confirmed the presence of castor-bean. It was now discovered that a new supply of grain had been delivered a few days previously. The corn chandler was communicated with and when the bulk grain from which the recent deliveries had been drawn was examined castor-beans were found.

All the cases followed a very similar story to that detailed in the case of the first horse. In all cases there was diarrhœa, although the onset of diarrhœa was in some instances delayed as long as two-three days. The character of the diarrhœa varied from that such as one gets after a strong physic ball to an almost watery fluid. In no case, not even in the fatal ones, was there any sign of blood. Also, although the horses partook of the same food and at approximately the same time, for it happened when a fresh supply of grain was received, and although they all showed the first preliminary symptom, i.e., turning away after a few mouthfuls, the onset of the more serious symptoms did not conform to a common time factor. In some the onset of these symptoms was a matter of hours, as in case one, but in many there was an interval of several days. When the cause was defined treatment was warmth and sedatives. A number of horses died (seven); the others gradually recovered and were back at work in from 14 to 21 days. Recovery took the longest time in those cases in which purgation was delayed.

In all cases there was extreme muscular weakness and the animals seemed to know that they must do their best to stand up, in spite of this weakness. Those that gave up and went down died.

Post-mortem findings in the latter were interesting, and I have fortunately preserved these records, of which the following is typical:—

A bay vanner mare, aged eight or nine years, with a blaze on face and two white stockings in the hind limbs. The animal was well nourished and in good bodily condition.

The peritoneum was injected. The walls of the stomach and intestines

were anæmic and somewhat œdematous. The stomach contents were in a semi-fluid state. The whole of the small intestine and large intestine were distended by fluid ingesta and fæces, with the exception of the small colon and rectum, which contained semi-fluid fæces.

The mucous lining of the stomach was inflamed in the region of the fundus.

There were patchy areas of inflammation in the mucous membrane of the small intestine, along its mesenteric curve. The cæcum and colon had similar patches, especially near the ileo-cæcal valve, and along the lines of mesenteric attachment. The mucous lining of the small colon and rectum was not inflamed. The great mesentery showed inflammatory streaks or lines all leading to its root and associated with the course of the mesenteric blood vessels and lymphatics.

The liver, kidneys and spleen were swollen and showed some degree of œdema and cloudy swelling.

The lungs were œdematous, the bronchi and trachea being full of frothy œdematous fluid. The pharynx, larynx and trachea showed injection of their mucous lining.

There was great engorgement of the right side of the heart.

The mesenteric and bronchial and hepatic lymphatic glands were swollen and œdematous.

We came to the conclusion that the immediate cause of death was due to heart failure, consequent upon the abdominal and associated thoracic conditions enumerated.

In thinking over these cases three things appear to stand out: (1) Castor-beans must be distasteful to horses, for not one of the horses ate more than a few mouthfuls of the contaminated food; (2) the small amount of the bean which can give rise to toxic effects; and (3) the delayed action in many of the cases.

Investigation as to the source of contamination of the grain showed that it had occurred when the grain boat was unloaded. Apparently castor-beans had been carried in the same hold and in bags. Evidently some bags had burst or spilled. The grain was loose and was extracted by a suction pump and the spilled beans had been accidently included. The grain was bagged direct from the suction pump. The owner of the stud ground all his grain and the bags had been tipped straight into his mill. If this had not been the case probably the beans might have been noticed.

The legal consequences were interesting. The corn chandler admitted liability and paid compensation through the courts. The liability was then automatically transferred from one party to another until it came back to the shipper from the country of origin.

DOUBLE EXTERNAL OS IN CATTLE

By D. N. SPRIGGS, B.Sc., M.R.C.V.S.

Introduction

DURING the course of infertility and obstetrical work in cattle, several observers have noticed the apparent presence of two cervices. Closer examination through a vaginal speculum has indicated that this impression is created by the presence of a fleshy vertical band which passes from the roof to the floor of the anterior vagina and divides the os uteri externum into two distinct parts.

Owing, perhaps, to the comparative rarity of this condition, its clinical significance is not authentically known.

Craig[1] states that this abnormality did not appear to influence fertility.

Quinlan[2] observed the defect in four cows, in all of which parturition had occurred normally on several occasions. In only one case, where the band was large and T-shaped, had it apparently caused some infertility. In the other cows, the structure was present as a thick band of tissue covered with mucosa, 3-8 cm. by 3-6 cm. in size, its cranial surface closely applied to the ostium uterinum externum, allowing the passage of two or three fingers between it and the cervix. Quinlan agrees with the general viewpoint that the condition is due to persistence of the median walls of the Muellerian ducts. He advises division of the band with an ecraseur.

Stuhlenmiller[3] describes the abnormality as a congenital one, and regards it as a less severe form of *uterus duplex,* due to total failure of fusion of the Muellerian ducts.

Williams[4] says that the structure is ¼-1 in. in diameter and finds that in most cases one can hook the index finger around it and draw the whole cervix back to the vulva. He warns against mistaking this double os uteri externum for a complete double cervix or *uterus didelphys.* There is no reliable data as to the fertility of affected cows, but normally the structure does not interfere with conception. At parturition, a fœtal limb might pass on either side of the band or the fœtal membranes might become detained around it, so it is advisable to sever it with a scalpel or scissors. The author recommends that the progeny of both sexes from affected animals should be discarded.

Fincher and Williams[6] describe the condition occurring in an incestuously-bred herd of Holsteins, over half of which showed gross genital defects as a result of arrested development of the Muellerian ducts. Vertical bands in the vagina were observed in two heifers, both of which had perilous pregnancies. In a further heifer, the uteri and cervices had remained wholly separate to constitute a true *uterus didelphys;* the 32-day pregnancy, found in this animal post-mortem, was apparently approaching an early termination.

Murray (7) has encountered *cervix bifida* in one maiden heifer out of 70 specimens examined in the abattoir. Two clinical cases in heifers revealed a similar finding of two ora uteri externa, it being possible to pass a probe from one side to the other *in vivo.* In one animal there was no history available; in the other, two services had proved fruitless. Murray traces the evolution of genital anatomy through the various classes of mammalia. Every gradation is seen from the completely distinct right and left uterine cornua, bodies and cervices of the mouse and rabbit, through the intermediate types seen in domestic mammals with a bicornuate uterus and single cervix, up to the single pear-shaped uterus of women. The author concludes that *cervix bifida* in cattle appears to be the result of an "innate tendency of the cervical region to remain double, counteracting the more general tendency of the Muellerian ducts to fuse in the mid-line and preventing such fusion taking place in that segment." The condition is normally present in the 7.5 cm. bovine fœtus and generally disappears during subsequent fœtal life.

Scorgie and Ottaway[8] observed a thick fleshy band passing vertically across the os uteri in two maiden heifers. Each band was 1 in. wide in the middle and 1½ in. at its attachments. It was possible to insert two fingers between the band and the os uteri, but it was impossible to break the former

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by strong traction. Both heifers were inseminated and conception resulted. At the time of parturition in one heifer, considerable straining took place without expulsion of the calf. It was found that, although the fœtal head had protruded through the os, delivery of the rest of the calf was prevented by the vertical band. After cutting this structure, parturition was immediately completed. In the other heifer, the band was severed a few days before full term and no dystokia was experienced. Both heifers were sired by the same bull out of unrelated dams, but other daughters subsequently got by this bull were normal.

Case Records

No. 1. Roan Shorthorn Cow

Had one calf. Conceived to third service for second pregnancy after dividing the vertical band. This structure was essentially the same in cases 1-6. It consisted of a strong fibro-muscular cord, covered with mucosa, circular in cross-section, ½-1½ in. in diameter by 2-3 in. long, securely attached to the roof and floor of the vagina, where it adjoins the cervix. Through the vaginascope, this gave the appearance of two distinct cervical canals. *Per vaginam*, it was possible to hook the forefinger around the band and retract the cervix.

No. 2. Red and White Shorthorn Heifer

Was unsuccessfully inseminated once, but conceived to first service by a bull.

No. 3. Red Shorthorn Cow

Had eight calves. Was inseminated three times for the ninth pregnancy.

No. 4. Roan Shorthorn Virgin Heifer

Died from pneumonia before mating age. (See Fig. 1.)

No. 5. British Friesian Cow

Had three calves; has turned to the bull four times subsequently.

No. 6. Guernsey Cow

Has had three calves, three inseminations being needed for the last one. Her fourth pregnancy was effected by a single insemination. On inspection through the vaginascope, it appeared at first sight as if there were three external ora altogether. This impression was created by the hypertrophy of some annular cervical folds on the right side. Closer examination revealed that there was a left and a right external os as before, both opening into the common cervical canal.

No. 7. British Friesian Cow

Has had eight calves. Three services were required for each of the last two conceptions, but as one parturition was associated with a retained placenta, this was hardly surprising, in view of the cow's age.

The patent external os was deflected slightly to the right. On the vaginal mucous membrane, 2 in. to the left, was a small irregular depression, resembling a second rudimentary os uteri. It was found that the cervical canal did not communicate with the vagina on this side.

No. 8. British Friesian Cow

After a normal first parturition, she was unsuccessfully served on three occasions before a vaginal examination was undertaken. Two ora uteri externa were observed, together with a vertical membrane in the mid-line bisecting the vagina for a distance of 4 in. posteriorly from the cervix. The left os was

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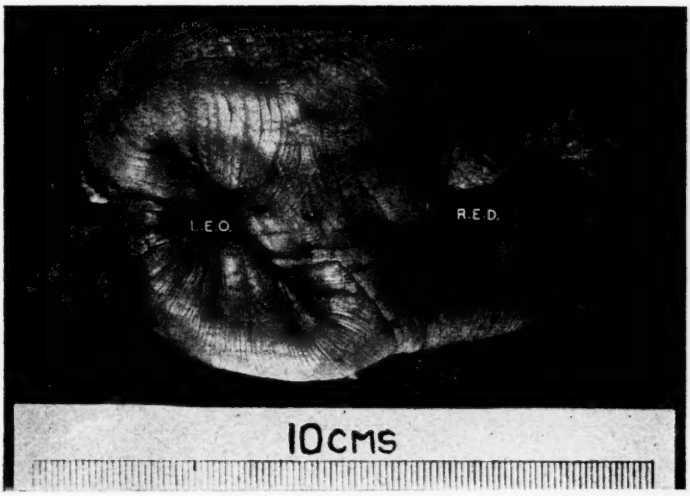

FIG. 1.

L.E.O.—Left external os.
V.B.—Fleshy vertical band.
R.E.D.—Right external os.

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blind to a probe. One insemination on the patent right side resulted in conception, but abortion occurred at three months' gestation.

No. 9. British Friesian Heifer

Two ora uteri externa were again visible, separated by a short vertical band. *Per rectum,* the median depression between the uterine cornua extended posteriorly right along the cervix, the uterine body apparently being absent. Whether this was a true case of *uterus didelphys* it was impossible to determine clinically.

Artificial insemination into both ora was successful at the second attempt, and a full-time calf was born normally.

No. 10. British Friesian Cow

She had been purchased three weeks after her first parturition, which was reputed to have taken place normally. Œstrum had generally been regular, but on two occasions it was manifested nine days post-coitum. A total number of ten services had proved ineffective.

The perineum was seen to be ruptured to a depth of 3 in., probably as a result of dystokia. The anterior vagina was bisected by a large membrane, which passed diagonally inferiorly and to the left, converging on to the external os anteriorly. A foramen, about 4 in. in diameter, formed a communication between the two halves of the vagina. The external os was situated in the right inferior cavity. A small spiral pit, discontinuous with the cervical canal, represented a rudimentary second os in the left ventral part of the vagina. The uterus was flaccid. The right ovary was quiescent. The left ovary contained a follicular cyst, the size of a cherry, and there were slight adhesions in the left ovarian bursa.

A poor prognosis was given. The ovarian cyst was ruptured. Insemination was performed into the patent external os at the next œstrum. A right horn pregnancy supervened.

Discussion

It is evident that many animals showing a divided os uteri externum of slight extent possess an unimpaired fertility record. Indeed, it is probable that the majority of affected cattle pass through life with the condition unrecognised. Three of the animals in this study were seen for the first time when inseminated, the remainder being encountered during routine examinations for infertility. It is very doubtful whether the condition would be diagnosed during rectal explorations for pregnancy diagnosis and infertility control. In some affected animals, the caudal extremity of the cervix appears enlarged *per rectum,* but no more so than is the normal state of affairs in many old cows, in which protrusion of cervical folds through the external os has occurred. If the cervix is firmly grasped through the rectum, however, and its oral region palpated with the thumb, one can suspect the presence of a median vertical band, and certain diagnosis may be made *per vaginam.*

It is surprising that the lesion does not commonly give rise to complications at parturition. One must assume that in the cervical dilatation during the first stage of labour, the band usually becomes deviated to one side, and the calf is uneventfully expelled through the larger opening.

Ætiology

The author would support the general opinion of other workers that the condition is due to persistence of the median walls of the Muellerian ducts. In the development of the bovine fœtus, these ducts arise from the intermediate

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mezoderm on either side. They pass inwards, meet and become fused in the mid-line; simultaneously canalisation takes place. The separate portions give rise in turn to the oviducts and uterine cornua; the fused portions together form the short uterine body, cervix and part of the vagina.

If the median walls of the Muellerian system persist throughout their length, a *uterus didelphys,* similar to the normal state in the mouse, results. It is of very rare occurrence in cattle. The two uterine and cervical cavities are quite distinct, and the breeding efficiency of affected cattle is poor. More frequently, only the caudal end of the cervix is involved, and if development is equal on each side, a vertical band across the external os is the result (see cases 1-6). Growth during the early embryonic period, however, may be somewhat asymmetrical, as in cases 7-10. Where fusion is incomplete more caudally, a thin vertical septum remains as a vestige in the anterior part of the vagina to a varying extent (see cases 8-10).

The only other logical explanation of the condition is that it results from an injury to the external os at a previous parturition. This hypothesis can be excluded, because :—

(a) The condition is found in maiden heifers.
(b) The site of the vertical band is constant, and one cannot visualise that the vaginal septum, sometimes co-existent, would arise as a result of dystokia.
(c) In every case, the band is so firmly attached at both extremities that a traumatic origin is unlikely.
(d) There is no history of dystokia in affected cows.
(e) An alternative explanation is available.

The significance of heredity in the ætiology of the lesion has not been definitely established. The circumstantial evidence supplied by the above ten animals would suggest that the hereditary influence was small. All the cases occurred sporadically on different farms, and it is probable that if other related animals were affected they would have been diagnosed, since most of the owners were members of the local artificial insemination scheme. It is noteworthy, however, that five animals were British Friesians, four Shorthorns, and one Guernsey. This high incidence in Friesians, compared with the cattle population in the district, possibly suggests a predisposition of the breed to the defect.

No close in-breeding was traceable in those animals whose family tree was known. Nevertheless, Fincher and Williams[6] have conclusively shown that the condition, in conjunction with more severe genital aberrations, may be associated with consanguineous mating in Holsteins. The limited evidence of Scorgie and Ottaway[8] suggests that the defect may be transmitted as a recessive genetic characteristic. Be that as it may, it is clear that the majority of cases, encountered in practice, are isolated ones, and the author cannot agree with Williams'[4] advice to "discard the progeny of both sexes from such animals."

Prognosis and Treatment

In those cases where the vertical band across the cervix is the only observable lesion, the breeding outlook for the animal is good. If the structure is of large dimensions, however, some degree of infertility may ensue. In non-pregnant animals the band should be severed. The simplest method is by introducing the hand into the vagina and cutting right through the structure with a pair of scissors or a hooked finger-knife. Little pain is evinced, hæmorrhage is slight, and there is no appreciable risk of serious infection. Pregnant cows are best

left untreated, in view of the possible abortifacient effect of the operation; the owners should be warned about possible complications at calving. If necessary, the band may be incised at the time of parturition, or a few weeks subsequently.

Vertical or diagonal septa in the fornix of the vagina, with the cervical canal patent on one side only, call for different treatment. This lesion provides one of the very few instances in the control of bovine infertility where artificial insemination may be expected to give a higher fertility rate than natural mating. The semen may be deposited in the functional external os, whereas the bull will ejaculate on the wrong side of the septum in many cases; moreover, effective natural service is hampered by the lateral deviation of the cervix.

In conclusion, the author appreciates that the condition of double external os in cattle is not a serious economic problem in comparison with the enormous losses experienced from other forms of infertility. He would put its incidence as well under 1 per cent. of cattle examined for breeding delays, and probably in the region of 0.2 per cent. of the total bovine population. Nevertheless, it is hoped that this paper will be of interest and practical assistance to veterinarians who encounter similar cervical and vaginal aberrations in individual animals from time to time.

Summary

(1) The relevant literature is briefly reviewed.

(2) The clinical history and examination of nine cows and heifers and the post-mortem findings of one heifer are described.

(3) The commonest lesion encountered was a short, thick, vertical, fibro-muscular band across the os uteri externum. The fertility of affected animals is good.

(4) A vertical septum was sometimes present in the mid-line of the anterior vagina, with the patent external os deviated to one side. Artificial insemination is recommended for such cattle.

(5) The condition is due to persistence of the median walls of the Muellerian ducts. Cases usually appear sporadically and the general incidence is low.

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NOTE.

Re the article by Dr. A. H. Quinn, who is Head of Department of Clinical Veterinary Medicine, Jensen-Salsbery Laboratories, Kansas City, published in our May issue, Vol. 101, 5, pages 112-113, we have received the following additional information from the author:—

"Further studies show that examination of birds for vaccination 'takes' should be made on the third day and not on the fifth day, as previously reported, the reason being that the new vaccine made from chick embryos is 'hotter' and the reaction comes up much faster than when the old-type vaccine made from tracheal exudates was used. Unless birds are checked on the third day a lot of the takes will be missed, as the reaction is fading fast by the fifth day."

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Abstracts of Current Literature

SPASTIC PARALYSIS IN DOMESTIC RABBITS*

VAIL, veterinarian of the Fish and Wildlife Service, U.S. Department of the Interior, has studied spastic paralysis (*Orcytolagus cuniculi*) in domestic rabbits in California since 1938. Rabbit breeders call the ailment "head down disease," in order to distinguish it from the malady known as wryneck. Spastic paralysis has a characteristic syndrome. The attack is sudden. The head is tucked on the floor between the forelegs with the ears touching each other, and the eyeballs are rotated outward and backward toward the outer canthus of the eye. In the standing position, the shoulder blades are spread apart and the gait is stilted. Handling causes a convulsion of several minutes that leads to pronounced exhaustion. Anorexia and dysphagia are marked. Drooling mats the fur. The mortality is 100 per cent. in untreated rabbits. The cause was traced to avitaminosis A. Case histories revealed that the affected rabbits had not eaten any succulent, green feed for periods ranging from eight to 18 months. Green feed or vitamin A in oil were found to be preventive and curative.

* *Journal of the American Veterinary Medical Association*, June, 1944.

EPIDEMIOLOGY OF TRICHINOSIS IN THE UNITED STATES†

RECOMMENDATION is made for nation-wide control of trichinosis since the examination of 5,313 diaphragms from hospitals in 37 states showed that the disease within the continental limits of the United States is quite uniform and that there is no correlation between trichina infection and sex, occupation, urban or rural residence or social-economic status. Among racial groups, the number of infected diaphragms found was 15.6 per cent. of 4,219 Americans; 23.5 per cent. of 769 foreign citizens; and 28.7 per cent. of a group of 380 Italians and Germans. In persons between 65 and 74 years old, the rate was 19.1 per cent. Live larvæ were found in 28.7 per cent. of 855 positive cases, and mixed dead and live larvæ in 16.6 per cent. The finding of dead larvæ in children of five to nine years indicated that larvæ may die within a few years after infection. This survey was made at 189 hospitals by the U.S. Public Health Service.

† Public Health Reports, May 28, 1944.

A NEW INVENTION FOR VETERINARY PRACTICE‡

REMOVING the upper beak of chicks prevents cannibalism—a deadly habit of brooding. With an apparatus he named the "billotine," Newlon of the University of California removes the upper beak at the rate of 200 chicks per hour. The apparatus consists of a special blade attached to an electric soldering iron hung on a string at a comfortable height, 5½ feet (1.65 m.). It is operated with the hands while standing, pulled downward by a cable attached to a foot pedal and returned to its upward position by the spring. The chick is brought into position for snipping and passed on.

‡ *Journal of the American Veterinary Medical Association*, June, 1944.

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